DRAFT FINAL
EXPANDED ENGINEERING EVALUATION/COST ANALYSIS (EEE/CA)
FOR THE
McLAREN TAILINGS SITE
COOKE CITY, MONTANA

Engineering Services Agreement DEQ/MWCB 401027
Task Order Number 05

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8.0 DETAILED ANALYSIS OF RECLAMATION ALTERNATIVES

The purpose of the detailed analysis is to evaluate, in detail, reclamation alternatives for their effectiveness, implementability, and cost to control and reduce the toxicity, mobility, and/or volume of contaminated mine wastes at the McLaren Tailings Site. Only those reclamation alternatives that were retained after the preliminary evaluation and screening, as presented in Section 7.2, are included. For clarity, the retained alternative numbers are carried over from Section 7.2. Each reclamation alternative currently being considered for implementation at the McLaren Tailings Site is classified as an interim or removal action and is not a complete remedial action. The reclamation alternatives evaluated in detail are applicable to the contaminated solid media; no reclamation alternatives for groundwater, surface water, or contaminated stream sediments are analyzed in detail. The rationale for not directly developing reclamation alternatives for these environmental media is based primarily on the presumption that reclaiming the contaminant source(s) will subsequently reduce any problems associated with groundwater, surface water, or stream sediments at a significantly reduced cost.

As required by CERCLA and the NCP, reclamation alternatives that were retained after the initial evaluation and screening have been evaluated individually against the following criteria:

- Overall protection of human health and the environment;
- Compliance with ARARs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability; and
- Cost.

Supporting agency acceptance and community acceptance are additional criteria that will be addressed after the DEQ/MWCB and the public has a chance to review the evaluations presented. The analysis criteria have been used to address the CERCLA requirements and considerations with EPA guidance (EPA, 1988), as well as additional technical and policy considerations. These criteria serve as the basis for conducting the detailed analysis and subsequently selecting the preferred reclamation alternative(s). The criteria listed above are categorized into three groups, each with distinct functions in selecting the preferred alternative. These groups include:

- Threshold Criteria - overall protection of human health and the environment and compliance with ARARs;

- Primary Balancing Criteria - long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost; and

- Modifying Criteria - state and community acceptance.

"Overall protection of human health and the environment and compliance with applicable or relevant and appropriate requirements" are threshold criteria that must be satisfied for an alternative to be eligible for selection. Long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; and cost are the primary balancing factors used to weigh major trade-offs between alternative hazardous waste management strategies. State and community acceptance are modifying considerations that are formally considered after public comment is received on the proposed plan and the EEE/CA report (Federal Register, No. 245, 51394-50509, December 1988). Each of these criteria is briefly described in the following paragraphs.

The overall protection criterion evaluates how the alternative, as a whole, protects and maintains human health and the environment. The overall assessment of protection is based on a combination of factors assessed under other evaluation criterion, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Compliance with ARARs criterion assesses how each alternative complies with applicable or relevant and appropriate standards, criterion, advisories, or other guidelines. Waivers will be identified, if necessary. The following factors will be addressed for each alternative during the detailed analysis of ARARs:

- Compliance with chemical-specific ARARs;
- Compliance with action-specific ARARs;
- Compliance with location-specific ARARs; and
- Compliance with appropriate criterion, advisories, and guidelines.

Long-term effectiveness and permanence evaluates the alternative's effectiveness in protecting human health and the environment after response objectives have been met. The following components of the criterion will be addressed for each alternative:

- Magnitude of remaining risk;
- Adequacy of controls; and
- Reliability of controls.

The reduction of toxicity, mobility, or volume assessment evaluates anticipated performance of the specific treatment technologies. This evaluation focuses on the following specific factors for a particular reclamation alternative:

- The treatment process, the remedies they will employ, and the materials they will treat;
- The amount of contaminated materials that will be destroyed or treated, including how principle threat(s) will be addressed;
- The degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction (or order of magnitude);
- Degree to which the treatment will be irreversible; and
- The type and quantity of treatment residuals that will remain following treatment.

Short-term effectiveness evaluates an alternative's effectiveness in protecting human health and the environment during the construction and implementation period until the response objectives are met. Factors that will be considered under this criterion include:

- Protection of the surrounding community during reclamation actions;
- Protection of on-site workers during reclamation actions;
- Protection from environmental impacts; and
- Time until removal response objectives are achieved.

Implementability evaluates the technical and administrative feasibility of alternatives and the availability of required resources. Analysis of this criterion will include the following factors and subfactors:

<u>Technical Feasibility</u>

- Construction and operation;
- Reliability of the technology;
- Ease of undertaking additional reclamation actions (if necessary); and
- Monitoring considerations.

<u>Administrative Feasibility</u>

- RCRA disposal restrictions;
- Institutional Controls; and
- Permitting requirements.

<u>Availability of Services and Materials</u>

- Adequate off-site treatment, storage capacity, and disposal services;
- Necessary equipment and specialists, and provisions to ensure any necessary additional resources;
- Timing of the availability of technologies under considerations; and
- Services and materials.

The cost assessment evaluates the estimated capital costs associated with each alternative. Cost screening consists of developing conservative, order-of-magnitude cost estimates based on similar sets of site-specific assumptions. Cost estimates for each alternative will consider the following factors:

<u>Capital Costs</u>

- Construction costs;
- Equipment costs;
- Land and site development costs;
- Disposal costs;

- Legal fees, license, and permit costs;
- Startup and troubleshooting costs; and
- Contingency allowances.

Annual Costs

- Operating labor;
- Disposal residues;
- Administrative costs;
- Insurance, taxes, and licensing;
- Contingency funds; and
- Rehabilitation costs.

Cooperating Agency acceptance will evaluate the technical and administrative issues and concerns the State may have regarding each of the alternatives. State acceptance will also focus on legal issues and compliance with State statutes and regulations. ***Community acceptance*** will incorporate public concerns into the analyses of the alternatives.

The final step of this analysis is to conduct a comparative analysis of the alternatives. The comparative analysis includes a discussion of the alternative's relative strengths and weaknesses with respect to each of the criterion and how reasonable key uncertainties could change expectations of their relative performance.

Once completed, this evaluation will be used to select the preferred alternative(s). The selection of the preferred alternative(s) will be documented in a Notice of Decision by the DEQ/MWCB. Public meetings to present the alternatives will be conducted and significant oral and written comments will be addressed in writing.

8.1 QUANTITATIVE EVALUATION OF THRESHOLD CRITERIA

In the following detailed evaluations of the threshold criteria, each reclamation alternative contains quantitative estimates of risk reduction as well as estimates regarding whether ARARs would be attained by implementing the alternative. To quantitatively assess the threshold criteria (overall protection of human health and the environment and attainment of ARARs), the exposure pathways of concern that were identified in the baseline risk assessment (human health and ecologic) were evaluated to determine the risk reduction required to achieve the desired residual risk level (HQ $\leq$1.0 and EQ $\leq$1.0). Each alternative was then modeled to ascertain the degree of risk reduction achieved, either through reduced contaminant loadings to an exposure pathway or reduced surface area available for certain exposures. The resulting risk reduction estimates are then compared to one another to determine whether the relative risk reduction provided by a specific alternative is greater than another; these risk reductions are also compared to the reduction required to alleviate excess risk via the specific pathway or media, as determined in the risk assessments. The risk reduction models also estimate resultant contaminant concentrations in the various media, which are then compared to media- and contaminant-specific ARARs. The groundwater model uses an on-site, downgradient exposure point, while the surface water/sediment model uses the sample station location below the sources at the site on Soda Butte Creek (SW-2) as the evaluation point.

Modeling estimates and assumptions are used in an attempt to quantify risk reduction and determine whether ARARs would be attained. In the course of performing this quantitative analysis, several assumptions and estimates are necessarily employed. Some of the assumptions are based on standard CERCLA risk assessment guidance, while others are based on site-specific observations and professional judgment. Many of the estimates are based on conservative (worst-case) scenarios, but since alternatives are compared to one another on a relative basis, these assumptions are consistent. The evaluation findings should, therefore, not be considered absolute (i.e., ARARs); however, the relative risk reduction differences between alternatives are meaningful and can be used to evaluate these criteria.

The human health baseline risk assessment determined that the pathways and COCs at the McLaren Tailings Site are soil ingestion of Cu and Fe and water ingestion of Fe. To effect risk reduction for these contaminants via the corresponding pathways, two scenarios were evaluated in the risk assessment: a recreational exposure and a residential exposure. Each reclamation alternative is modeled for the two scenarios and the resultant risk reductions are compared to the reduction required to achieve these levels of protectiveness (recreational and residential): Fe via soil ingestion 91 percent (residential); Cu via soil ingestion 59 percent (residential); and Fe via water ingestion 89 percent (residential). Refer to Table 5-3 for pathway- and contaminant-specific risk reduction goals.

The ecologic risk assessment identified one exposure scenario: plant phytotoxicity to Cd and Cu. The plant phytotoxicity scenario requires a 98 percent reduction in surface concentrations or surface area to achieve no phytotoxic effects from Cu.

The three exposure pathways were modeled to evaluate the relative risk reductions and attainment of ARARs afforded by each alternative. These calculations involved a combination of measured data collected at the site (waste and surface water concentrations), and modeled impacts (i.e., groundwater loading). A discussion of how the evaluations were performed and the assumptions used follows for each pathway.

The groundwater pathway was modeled using a simple mathematical model that utilizes two components: estimates of leachate concentrations for precipitation water that flows through the waste sources and/or repository and ultimately into groundwater; and estimates of the rate that this water flows through the wastes and/or repository (flux). The first component, leachate concentrations, were obtained by using the TCLP analyses performed during the 2001 reclamation investigation on composite samples of the waste sources. The second component, water flux through the sources, was estimated using the HELP (Version 3.0) model, which uses a variety of site meteorological and physical data to determine the water balance at the site, including estimating the volume of water flux through the bottom of an impoundment. Each source was evaluated, as was the background groundwatershed. Assumptions used to evaluate groundwater impacts (loadings) include the following: inputs from the sources and background were summed, which has the effect of assuming complete mixing and dilution and not considering any other contaminant attenuation mechanisms; repository loads were summed with the other loads as a total loading to groundwater.

The surface water pathway was also modeled using a simple mathematical model. This model utilized two components: measured surface water concentrations above and below the site wastes; and an estimate of the relative increases in surface water loading provided by each source, based on relative contaminant concentrations in each source, the area of the source, and the proximity of each source to a surface water conveyance.

Assumptions used to evaluate surface water impacts (loadings) include the following: alternatives that employed soil covers or caps were assigned a 65 percent long-term effectiveness for preventing erosion into surface water; sources placed in a repository with a multi-layered cap were assumed to have been 90 percent removed from exposures via this pathway; and sources moved off-site were assumed to have been 100 percent removed from exposures via this pathway.

The soil exposure pathways were empirically modeled using only reductions in surface area to estimate reduction in exposures. This pathway also assumed a 65 percent long-term effectiveness for maintaining adequate cover to prevent exposure due to the possibility of long-term deterioration of the clean soil cover. Sources placed in a repository with a multi layered cap were assumed to have been 90 percent removed from exposures via this pathway; and sources moved off-site were assumed to have been 100 percent removed from exposures via this pathway.

8.2 ALTERNATIVE 1: NO ACTION

The No Action Alternative is required for analysis by CERCLA and the NCP when evaluating alternatives in detail; the No Action Alternative is used to provide a baseline for comparing other alternatives. Under this alternative, no permanent reclamation activities would be implemented. Consequently, long-term human health and environmental risks associated with the on-site contamination would remain unchanged, with the contaminant sources at the site continuing to pose a threat to human health and environmental resources.

8.2.1 Overall Protection of Human Health and the Environment

The No Action Alternative provides no control of exposures to contaminated materials and no reduction in risk to human health or the environment. It allows for the continued migration of contaminants and further degradation of groundwater and surface water quality.

Protection of human health would not be achieved under the No Action Alternative. Prevention of human exposure to COCs via the pathways of concern, as identified in the human health risk assessment, would not occur. Soil ingestion exposure to Fe and Cu via contaminated surface soil and groundwater ingestion of Fe would not be reduced, meeting none of the risk reduction goals for the site. Protection of the environment would also not be achieved under the No Action Alternative. Prevention of ecologic exposures via the scenario identified in the ecologic risk assessment would not occur (plant phytotoxicity to Cd and Cu would persist).

A risk reduction achievement matrix (Table 8-1) was developed to assess whether the alternative affords sufficient protection to human health and the environment for the pathways and COCs identified in the human health risk assessment and the ecological risk assessment. The conclusions presented on the table are based on worst-case modeling results and are subject to the limitations and assumptions used in the models.

TABLE 8-1
RISK REDUCTION ACHIEVEMENT MATRIX - ALTERNATIVE 1

Alternative 1	As	Cd	Cu	Fe	Zn	Overall
Human Health Exposure Pathways:						
Soil Ingestion	Res.	Res.	Recr.	Recr.	Res.	Recr.
Water Ingestion	Res.	Res.	Res.	Recr.	Res.	Recr.
Ecologic Exposure Pathways:						
Surface Water	--	--	--	–	--	Yes
Sediments	--	--	--	--	--	Yes
Plant Phytotoxicity	--	No	No	--	--	No

-- = Risk reduction not required for the contaminant for that pathway.
Recr. = Achieves required risk reduction for the recreational exposure scenario.
Res. = Achieves required risk reduction for the residential exposure scenario (most protective).

8.2.2 Compliance with ARARs

A comprehensive list of Federal and State ARARs has been developed for the McLaren Tailings Site and is summarized in Section 4.0 and presented in detail in Appendix E. The ARARs are divided into contaminant-specific, location-specific, and action-specific requirements. Contaminant-specific ARARs are waste-related requirements which specify how a waste must be managed, treated, and/or disposed depending upon the classification of the waste materials. Location-specific ARARs specify how the remedial activities must take place depending upon where the wastes are physically located (i.e., in a stream or floodplain, wilderness area, or sensitive environment, etc.), or where the wastes may be treated or disposed, and what authorizations (permits) may be required. Action-specific ARARs are technology- or activity-based requirements, or are limitations on actions taken with respect to hazardous substances. Action-specific ARARs do not determine the preferred reclamation alternative, but indicate how the selected alternative must be achieved.

Under the No Action Alternative, no contaminated materials would be treated, removed, or actively managed. Consequently, the No Action Alternative would not satisfy Federal or State ARARs. A water quality ARARs attainment matrix (Table 8-2) was developed to assess whether the alternative can achieve ARARs for those contaminants and media where they are exceeded.

The conclusions presented on the table are based on worst-case modeling results and are subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-2
WATER QUALITY ARARs ATTAINMENT FOR ALTERNATIVE 1

Alternative 1	As	Cd	Cu	Fe	Pb	Zn
On-site Groundwater (µg/L)	2.9	1.1	NM	380	3.1	NM
On-site Surface Water (µg/L)	2.2	0.2	2	2,800	1.2	14.7
On-site Groundwater ARARs	Yes	Yes	--	No	Yes	--
On-site Surface Water ARARs	Yes	Yes	Yes	No	Yes	Yes

Groundwater ARARs are State HHSs.
Surface water ARARs are State HHSs or Acute AWQC, whichever is lower.
NM = Contaminant not modeled (Cu and Zn not included in TCLP suite).
µg/L = micrograms per Liter

On-site groundwater and surface water would not meet contaminant-specific water quality ARARs for iron under this alternative.

8.2.3 Long-Term Effectiveness and Permanence

No controls or long-term measures would be placed on the contaminated materials at the site; consequently, all current and future risks would remain the same as described in the baseline risk assessment (Section 5.0). Therefore, the No Action Alternative would not be effective at minimizing risks from exposure to these materials. Additionally, under the No Action Alternative, the tailings impoundment would remain in its current potentially unstable location directly in the valley bottom of the Soda Butte Creek drainage; consequently, the risk of potential catastrophic failure of the tailings dam would remain.

8.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The No Action Alternative would provide no reduction in toxicity, mobility, or volume of the contaminated materials.

8.2.5 Short-Term Effectiveness

In the short term, the No Action Alternative would pose no additional threats to the community or the environment as the current site conditions. The time required until reclamation objectives are reached (by natural contaminant degradation and erosion) would be indefinite and would most likely be measured in terms of geologic time frames.

8.2.6 Implementability

There would be no implementability concerns posed by the No Action Alternative since no action would be taken.

8.2.7 Costs

The cost for implementing this alternative would be zero since no action would be taken.

8.3 ALTERNATIVE 4: PARTIAL REMOVAL AND IN-PLACE CONTAINMENT

Section 7.3.4 of this document presents the conceptual design, design assumptions, logistics, and construction details associated with Alternative 4.

8.3.1 Overall Protection of Human Health and the Environment

Alternative 4 would provide a means of reducing soil ingestion exposure to the COCs and would partially stabilize the surfaces of the sources with respect to migration to surface water and groundwater. However, while implementing this alternative would be an improvement over current site conditions, the waste sources would still be physically located along Soda Butte Creek and the potential for future contaminant releases to surface water would continue to exist. Consequently, the reduction in risk to human health and the environment would not be sufficient to achieve the risk reductions dictated by the risk assessment. Alternative 4 would allow for the continued, though reduced, migration of contaminants and degradation of groundwater and surface water quality. Alternative 4 does provide significant (but insufficient) reduction of soil ingestion exposure.

Some protection of human health would be achieved under this alternative. Reduction of human exposures to the COCs via the pathways of concern, as identified in the human health risk assessment, would occur. Soil ingestion exposure to the COCs via contaminated surface soil would be sufficiently reduced for recreational exposures; however, Fe would not be reduced sufficiently to meet the residential risk reduction levels. Groundwater ingestion of Fe would also not be reduced sufficiently to meet residential risk levels.

Limited protection of the environment would also be achieved under this alternative. However, reduction of most ecologic exposures, via the scenarios identified in the ecologic risk assessment, would not occur: plant phytotoxicity to Cu would not be sufficiently reduced.

A risk reduction achievement matrix (Table 8-3) was developed to assess whether the alternative affords sufficient protection to human health and the environment for the pathways and COCs identified in the human health risk assessment (Section 5.1) and the ecological risk assessment (Section 5.2). The conclusions presented on the table are based on worst-case modeling results and are subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-3
RISK REDUCTION ACHIEVEMENT MATRIX - ALTERNATIVE 4

Alternative 4	As	Cd	Cu	Fe	Zn	Overall
Human Health Exposure Pathways:						
Soil Ingestion	Res.	Res.	Res.	Recr.	Res.	Recr.
Water Ingestion	Res.	Res.	Res.	Recr.	Res.	Recr.
Ecologic Exposure Pathways:						
Surface Water	--	--	--	–	--	Yes
Sediments	--	--	--	--	--	Yes
Plant Phytotoxicity	--	Yes	No	--	--	No

-- = Risk reduction not required for the contaminant for that pathway.
Recr. = Achieves required risk reduction for the recreational exposure scenario.
Res. = Achieves required risk reduction for the residential exposure scenario (most protective).

8.3.2 Compliance with ARARs

All location-specific and action-specific ARARs would be met by implementing this alternative. There are no chemical-specific, numerical standards (ARARs) that are required to be met for contaminated solid media. Chemical-specific water quality ARARs are not expected to be achieved by this alternative. A water quality ARARs attainment matrix (Table 8-4) was developed to assess whether the alternative can achieve ARARs for those contaminants and media where they are exceeded. The conclusions presented on the table are based on worst-case modeling results and are subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-4
WATER QUALITY ARARs ATTAINMENT FOR ALTERNATIVE 4

Alternative 4	As	Cd	Cu	Fe	Pb	Zn
On-site Groundwater (µg/L)	1.3	0.2	NM	110	3.1	NM
On-site Surface Water (µg/L)	1.7	0.1	2	440	1.2	13
On-site Groundwater ARARs	Yes	Yes	--	Yes	Yes	--
On-site Surface Water ARARs	Yes	Yes	Yes	No	Yes	Yes

Groundwater ARARs are State HHSs.
Surface water ARARs are State HHSs or Acute AWQC, whichever is lower.
NM = Contaminant not modeled (Cu and Zn not included in TCLP suite).
µg/L = micrograms per Liter

On-site groundwater would meet water quality ARARs under this alternative. On-site surface water would not meet water quality ARARs for Fe under this alternative.

8.3.3 Long-Term Effectiveness and Permanence

Frequent inspection and maintenance would be required to ensure the long-term effectiveness of this alternative. The inlet of the culvert installed through the tailings dam would be prone to plugging during high runoff events and would likely need to be cleaned out several times per year. Additionally, the riprap armoring installed along the banks of the constructed channels within the tailings footprint may require replenishment or reinforcement after major flood events. The riprap armoring is a very important component of this alternative because it is intended to prevent Miller Creek and Soda Butte Creek flows from scouring and eroding the reclaimed side slopes of the constructed channels, which would actually be recontoured and covered mill tailings under this alternative. Although this alternative would aid in dehydrating and stabilizing the tailings impoundment, and would eliminate a major source of infiltrating water into the tailings, the tailings impoundment would still remain in its current, potentially unstable location directly in the valley bottom of the Soda Butte Creek drainage; consequently, the risk of catastrophic failure of the tailings dam would not be completely eliminated.

The soil covers and run-on controls installed as part of this alternative would have to be maintained to ensure that they continue to perform as designed. The soil covers would be susceptible to settlement, ponding of surface water, erosion, and disruption of cover integrity by vehicles, deep-rooting vegetation, and burrowing animals. However, the covers could be easily inspected and the required maintenance could be easily determined.

Grading and revegetation of the mine wastes would stabilize these sources by providing an erosion-resistant, vegetated surface that would provide some protection from surface water and wind erosion, and would reduce net infiltration through the contaminated media by increasing evapotranspiration processes. Revegetation would consequently reduce the threat of direct contact and inhalation of airborne contaminants by on-site and nearby receptors. The long-term effectiveness of the revegetation would be enhanced by determining proper amendments, and selecting appropriate plant species, adapted to short growing seasons and high altitudes (as opposed to selecting native species exclusively).

Over the long term, the water quality and sediment environment (benthic community) in Soda Butte Creek are expected to improve by implementing this alternative. The stream is expected to benefit because the contaminant sources impacting the stream would be stabilized with respect to surface water erosion. Additionally, the in-place containment strategy would improve the aesthetic quality of the area. The long-term effectiveness should be monitored by frequent inspections of the reclaimed wastes and subsequent maintenance, when necessary.

8.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The primary objective of this alternative is to provide a reduction in contaminant mobility; the volume or toxicity of the contaminants would not be reduced by implementing this alternative. In-place grading, covering and revegetation of the mine waste sources would stabilize the sources and reduce contaminant mobility via surface water and wind erosion. Potential groundwater impacts would also be reduced by decreasing infiltration through the waste sources by increasing evapotranspiration processes, as well as by removing a major source of infiltrating water into the tailings (relocation of Soda Butte Creek back into the valley bottom). The mobility of the on-site contaminants is expected to be reduced to an extent that would result in an overall (all pathways and all routes of exposure considered) risk reduction of 79 percent (based on modeling results).

8.3.5 Short-Term Effectiveness

It is anticipated that the construction phase of this alternative would be accomplished in a relatively short time period (one field season); therefore, impacts associated with construction should be short term and minimal.

On-site workers would be adequately protected during the construction phase by utilizing appropriate personal protective equipment and by following proper operating and safety procedures; however, short-term water quality and air quality impacts to the surrounding environment may occur due to the relatively large volumes of wastes requiring handling. Control of fugitive dust emissions would be provided by applying water (via water truck) to surfaces receiving heavy vehicular traffic, or in excavation areas, etc.

Short-term impacts to the surrounding community may be appreciable considering the proximity of the site in relation to Cooke City, which has a relatively small resident population but receives considerable tourist traffic throughout most of the year. Short-term impacts to the surrounding community would involve increased local vehicle traffic and associated safety hazards, as well as increased noise levels and dust generation. Application of water to roads in areas may become necessary if dust generation is significant.

This alternative may impart short-term impacts on Soda Butte Creek (and possibly Miller Creek) due to the need to work in close proximity to the streams and/or excavate wastes from the floodplains. Additionally, this alternative may require installation of a surface water diversion structure(s) in Soda Butte Creek and/or Miller Creek to allow reconstruction of the stream channels through the existing footprint of the tailings impoundment. However, the existing by-pass channel that runs on the north side of the tailings impoundment could likely be utilized as a diversion to convey the majority of the flow of the streams while the channels are reconstructed.

Short-term impacts to environmental resources are difficult to quantify; however, every effort would be made to minimize impacts to Soda Butte Creek and potential downstream receptors during implementation of this alternative. Partial excavation of the tailings impoundment would expose un-weathered (reduced) tailings materials to water and oxygen that could potentially result in an increased production of acid rock drainage (ARD) over the short term. To minimize this possibility, the newly exposed tailings would be isolated from excess water to the extent practical via dewatering during the excavation process. Dewatering would likely consist of construction of a series of trenches and sumps, and installation of pumps to remove excess water from the immediate excavation area. The exact dewatering method to be employed would be determined during the detailed design phase of the project. Application for water quality permits, required as part of State and Federal Agency approval of the reclamation plan, would also aid in planning for protecting Soda Butte Creek from short-term impacts during the construction phase of the project. Additionally, BMPs would be required to be implemented during construction to protect surface water resources.

8.3.6 Implementability

This alternative is both technically and administratively feasible, and could likely be implemented in a relatively short period of time (one construction season, assuming favorable weather conditions at 7,600 feet elevation). The excavating, grading, covering and revegetation steps required are considered conventional construction practices; materials and construction methods are readily available. Also, design methods and requirements are well documented and well understood. However, the construction steps required to implement this alternative are considered moderately difficult due to the need to work with wet tailings.

Factors that could affect the implementability of this alternative include the potential to encounter significant groundwater beneath the tailings when excavating the new channels, and attempting to cut slopes and operate equipment on wet tailings. If significant groundwater is encountered when excavating the materials, dewatering (i.e., pumping) will likely be required during construction. Additionally, pre-treatment of wet materials may be necessary to eliminate free liquids if materials are hauled off-site for disposal. De-watering and/or pre-treatment, if required, could significantly increase project costs. Significant groundwater was not encountered beneath the tailings during the 2001 field investigation; however, the investigation was conducted during September (when the groundwater hydrograph is typically at its minimum) under regional drought conditions.

8.3.7 Costs

The total cost for this alternative has been estimated at $2,709,112.00, which represents the reclamation of all solid media contaminant sources present at the McLaren Tailings Site. Table D-2, in Appendix D, presents the cost details and assumptions associated with implementing this alternative.

8.4 <u>ALTERNATIVE 5a: ON-SITE DISPOSAL IN A FULLY ENCAPSULATED REPOSITORY</u>

Section 7.3.5 of this document presents the conceptual design, design assumptions, logistics, and construction details associated with Alternative 5a.

8.4.1 Overall Protection of Human Health and the Environment

This alternative would provide a means of significantly reducing soil ingestion exposure to the COCs and would stabilize the surfaces of the sources with respect to migration to surface water. The reduction in risk to human health and the environment would be sufficient to achieve the risk reductions dictated by the risk assessment. Alternative 5a would sufficiently mitigate the migration of contaminants and degradation of groundwater and surface water quality and provides sufficient reduction of soil ingestion exposure.

Significant protection of human health would be achieved under this alternative. Reduction of human exposures to the COCs via the pathways of concern, as identified in the human health risk assessment, would occur. Soil ingestion exposure to COCs via contaminated surface soil would be sufficiently reduced for the residential risk reduction levels. Groundwater ingestion of Fe would also be reduced enough to meet residential risk levels.

Significant protection of the environment would also be achieved under this alternative. Reduction of ecologic exposures, via the scenarios identified in the ecologic risk assessment, would occur: plant phytotoxicity to Cu would be sufficiently reduced.

A risk reduction achievement matrix (Table 8-5) was developed to assess whether the alternative affords sufficient protection to human health and the environment for the pathways and COCs identified in the human health risk assessment (Section 5.1) and the ecological risk assessment (Section 5.2). The conclusions presented on the table are based on worst-case modeling results and are subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-5
RISK REDUCTION ACHIEVEMENT MATRIX - ALTERNATIVE 5a

Alternative 5a	**As**	**Cd**	**Cu**	**Fe**	**Zn**	**Overall**
Human Health Exposure Pathways:						
Soil Ingestion	Res.	Res.	Res.	Res.	Res.	Res.
Water Ingestion	Res.	Res.	Res.	Res.	Res.	Res.
Ecologic Exposure Pathways:						
Surface Water	--	--	--	–	--	Yes
Sediments	--	--	--	--	--	Yes
Plant Phytotoxicity	--	Yes	Yes	--	--	Yes

-- = Risk reduction not required for the contaminant for that pathway.
Recr. = Achieves required risk reduction for the recreational exposure scenario.
Res. = Achieves required risk reduction for the residential exposure scenario (most protective).

8.4.2 Compliance with ARARs

All location-specific and action-specific ARARs would be met by implementing this alternative. There are no numerical standards (ARARs) that are required to be met for contaminated solid media. Water quality ARARs are expected to be achieved by this alternative. A water quality ARARs attainment matrix (Table 8-6) was developed to assess whether the alternative can achieve ARARs for those contaminants and media where they are exceeded. The conclusions presented in the table are based on worst-case modeling results subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-6
WATER QUALITY ARARs ATTAINMENT FOR ALTERNATIVE 5a

Alternative 5a	**As**	**Cd**	**Cu**	**Fe**	**Pb**	**Zn**
On-site Groundwater (µg/L)	1.0	0.1	NM	7.9	0.9	NM
On-site Surface Water (µg/L)	1.6	0.1	2	24	1.2	12
On-site Groundwater ARARs	Yes	Yes	--	Yes	Yes	--
On-site Surface Water ARARs	Yes	Yes	Yes	Yes	Yes	Yes

Groundwater ARARs are State HHSs.
Surface water ARARs are State HHSs or Acute AWQC, whichever is lower.
NM = Contaminant not modeled (Cu and Zn not included in TCLP suite).
µg/L = micrograms per Liter

On-site groundwater and surface water would meet water quality ARARs under this alternative.

8.4.3 Long-Term Effectiveness and Permanence

Under this alternative, the constructed repository would have to be maintained to ensure that it continues to perform as designed. The actual design life of the repository is not certain; consequently, long-term monitoring and routine inspection and maintenance would be required. The leachate storage tank would need to be routinely monitored to determine pumping frequency. Additionally, the collected leachate would need to be sampled and analyzed to determine appropriate disposal options. This is a monitoring and maintenance issue that would need to be resolved prior to implementing this alternative.

The repository cap would be the component most vulnerable to any damage or degradation that might occur. Multi-layered caps are susceptible to settlement, ponding of surface water, erosion, and disruption of cover integrity by vehicles, deep-rooting vegetation, and burrowing animals. However, the cap could be easily inspected and the required maintenance could be easily determined and performed.

Under this alternative, the tailings impoundment would be completely removed from its current, potentially unstable location directly in the valley bottom of the Soda Butte Creek drainage; consequently, the risk of catastrophic failure of the tailings dam would be eliminated. Additionally, with the tailings completely removed and Soda Butte Creek returned to its original location in the valley bottom, a perennial source of infiltrating water into the tailings impoundment would be eliminated.

Over the long term, the water quality and sediment environment (benthic community) in Soda Butte Creek and Miller Creek are expected to improve by implementing this alternative. These streams are expected to benefit because the contaminant sources impacting the streams would be stabilized with respect to surface water erosion. Additionally, the alternative would improve the aesthetic quality of the area. The long-term effectiveness should be monitored by frequent inspections of the reclaimed wastes and subsequent maintenance, when necessary.

8.4.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The primary objective of this alternative is to provide a significant reduction in contaminant mobility; the volume or toxicity of the wastes would not be reduced by this alternative. The primary waste source of concern would be rendered immobile in an engineered structure and physical location that is protected from erosion problems. Completely removing and encapsulating the tailings and waste rock dump would stabilize the wastes and reduce contaminant mobility via surface water and wind erosion. Groundwater impacts would also be reduced by decreasing infiltration through the wastes by increasing evapotranspiration processes, as well as by removing a major source of infiltrating water into the tailings (relocation of Soda Butte Creek back into the valley bottom). The mobility of the on-site contaminants is expected to be reduced to an extent that would result in an overall (all pathways and all routes of exposure considered) risk reduction of 98 percent (based on modeling results).

The performance of the fully encapsulated repository, from the standpoint of reducing infiltration of percolating leachate to groundwater, was estimated using EPA's HELP Model (Version 3.0). Output from the HELP Model is included in Appendix F. Implementation of Alternative 5a is predicted to reduce infiltration of leachate at the McLaren Tailings Site by 99.97 percent.

8.4.5 Short-Term Effectiveness

It is anticipated that the construction phase of this alternative would be accomplished in a relatively short time period (one field season); therefore, impacts associated with construction would be short term and minimal. On-site workers would be adequately protected during the construction phase by utilizing appropriate personal protective equipment and by following proper operating and safety procedures; however, short-term water quality and air quality impacts to the surrounding environment may occur due to the large volumes of wastes requiring handling. Control of fugitive dust emissions would be provided by applying water (via water truck) to surfaces receiving heavy vehicular traffic, or in excavation areas, etc.

Short-term impacts to the surrounding community may be appreciable considering the proximity of the site in relation to Cooke City, which has a relatively small resident population but receives considerable tourist traffic throughout most of the year. Short-term impacts to the surrounding community would involve increased local vehicle traffic and associated safety hazards, as well as increased noise levels and dust generation. Application of water to roads in areas may become necessary if dust generation is significant.

This alternative may impart short-term impacts on Soda Butte Creek (and possibly Miller Creek) due to the need to work in close proximity to the streams and excavate wastes from the floodplains. Additionally, this alternative may require installation of a surface water diversion structure(s) in Soda Butte Creek and/or Miller Creek to allow reconstruction of the stream channels through the current footprint of the tailings impoundment. However, the existing by-pass channel that runs on the north side of the tailings impoundment could likely be utilized as a diversion to convey the majority of the flow of the streams while the channels are reconstructed.

Short-term impacts to environmental resources are difficult to quantify; however, every effort would be made to minimize impacts to Soda Butte Creek and potential downstream receptors during implementation of this alternative. Excavation of the tailings impoundment would expose un-weathered (reduced) tailings materials to water and oxygen that could potentially result in an increased production of ARD over the short term. To minimize this possibility, the newly exposed tailings would be isolated from excess water to the extent practical via dewatering during the excavation process. Dewatering would likely consist of construction of a series of trenches and sumps, and installation of pumps to remove excess water from the immediate excavation area. The exact dewatering method to be employed would be determined during the detailed design phase of the project. Application for water quality permits, required as part of State and Federal Agency approval of the reclamation plan, would also aid in planning for protecting Soda Butte Creek from short-term impacts during the construction phase of the project. Additionally, BMPs would be required to be implemented during construction to protect surface water resources.

8.4.6 Implementability

This alternative is both technically and administratively feasible, and could be implemented in a relatively short period of time (one construction season, assuming favorable weather conditions at 7,600 feet elevation). The excavation, hauling, lining, compacting, grading, capping, and revegetation steps required are considered conventional construction practices; materials and construction methods are readily available. Also, design methods and requirements are well documented and well understood. However, the construction steps required to implement this alternative are considered moderately difficult due to the need to work with wet tailings.

Factors that could affect the implementability of this alternative include the potential to encounter significant groundwater beneath the tailings when excavating and attempting to operate heavy equipment on wet tailings. If significant groundwater is encountered when excavating the materials, dewatering (i.e., pumping) will likely be required during construction. Additionally, pre-treatment of wet materials may be necessary to eliminate free liquids to attain compaction specifications in the repository. De-watering and/or pre-treatment, if required, could significantly increase project costs. Significant groundwater was not encountered beneath the tailings during the 2001 field investigation; however, the investigation was conducted during September (when the groundwater hydrograph is typically at its minimum) under regional drought conditions.

8.4.7 Costs

The total cost for this alternative has been estimated at $4,686,721.00, which represents the reclamation of all solid media contaminant sources present at the McLaren Tailings Site. Table D-3, in Appendix D, presents the cost details and assumptions associated with implementing this alternative.

8.5 ALTERNATIVE 5b: ON-SITE DISPOSAL IN AN UN-LINED REPOSITORY WITH A MULTI-LAYERED CAP

Section 7.3.6 of this document presents the conceptual design, design assumptions, logistics, and construction details associated with Alternative 5b.

8.5.1 Overall Protection of Human Health and the Environment

This alternative would provide a means of significantly reducing soil ingestion exposure to the COCs and would stabilize the surfaces of the sources with respect to migration to surface water. The reduction in risk to human health and the environment would be sufficient to achieve the risk reductions dictated by the risk assessment. Alternative 5b would sufficiently mitigate the migration of contaminants and degradation of groundwater and surface water quality, and would provide sufficient reduction of soil ingestion exposure.

Significant protection of human health would be achieved under this alternative. Reduction of human exposures to the COCs via the pathways of concern, as identified in the human health risk assessment, would occur. Soil ingestion exposure to COCs via contaminated surface soil would be sufficiently reduced for the residential risk reduction levels. Groundwater ingestion of Fe would also be reduced enough to meet residential risk levels.

Significant protection of the environment would also be achieved under this alternative. Reduction of ecologic exposures, via the scenarios identified in the ecologic risk assessment, would occur: plant phytotoxicity to Cu would be sufficiently reduced.

A risk reduction achievement matrix (Table 8-7) was developed to assess whether the alternative affords sufficient protection to human health and the environment for the pathways and COCs identified in the human health risk assessment (Section 5.1) and the ecological risk assessment (Section 5.2). The conclusions presented on the table are based on worst-case modeling results and are subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-7
RISK REDUCTION ACHIEVEMENT MATRIX - ALTERNATIVE 5b

Alternative 5b	As	Cd	Cu	Fe	Zn	Overall
Human Health Exposure Pathways:						
Soil Ingestion	Res.	Res.	Res.	Res.	Res.	Res.
Water Ingestion	Res.	Res.	Res.	Res.	Res.	Res.
Ecologic Exposure Pathways:						
Surface Water	--	--	--	–	--	Yes
Sediments	--	--	--	--	--	Yes
Plant Phytotoxicity	--	Yes	Yes	--	--	Yes

-- = Risk reduction not required for the contaminant for that pathway.
Recr. = Achieves required risk reduction for the recreational exposure scenario.
Res. = Achieves required risk reduction for the residential exposure scenario (most protective).

8.5.2 Compliance with ARARs

All location-specific and action-specific ARARs would be met by implementing this alternative. There are no numerical standards (ARARs) that are required to be met for contaminated solid media. Water quality ARARs are expected to be achieved by this alternative. A water quality ARARs attainment matrix (Table 8-8) was developed to assess whether the alternative can achieve ARARs for those contaminants and media where they are exceeded. The conclusions presented on the table are based on worst-case modeling results and are subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-8
WATER QUALITY ARARs ATTAINMENT FOR ALTERNATIVE 5b

Alternative 5b	As	Cd	Cu	Fe	Pb	Zn
On-site Groundwater (µg/L)	1.2	0.2	NM	29	1.1	NM
On-site Surface Water (µg/L)	1.6	0.1	2	47	1.2	12
On-site Groundwater ARARs	Yes	Yes	--	Yes	Yes	--
On-site Surface Water ARARs	Yes	Yes	Yes	Yes	Yes	Yes

Groundwater ARARs are State HHSs.
Surface water ARARs are State HHSs or Acute AWQC, whichever is lower.
NM = Contaminant not modeled (Cu and Zn not included in TCLP suite).
µg/L = micrograms per Liter

On-site groundwater and surface water would meet water quality ARARs under this alternative.

8.5.3 Long-Term Effectiveness and Permanence

Under this alternative, the constructed repository would have to be maintained to ensure that it continues to perform as designed. The actual design life of the repository is not certain; consequently, long-term monitoring and routine inspection and maintenance would be required. The repository cap would be the component most vulnerable to any damage or degradation that might occur. Multi-layered caps are susceptible to settlement, ponding of surface water, erosion, and disruption of cover integrity by vehicles, deep-rooting vegetation, and burrowing animals. However, the cap could be easily inspected and the required maintenance could be easily determined and performed.

Under this alternative, the tailings impoundment would be completely removed from its current, potentially unstable location directly in the valley bottom of the Soda Butte Creek drainage; consequently, the risk of catastrophic failure of the tailings dam would be eliminated. Additionally, with the tailings completely removed and Soda Butte Creek returned to its original location in the valley bottom, a perennial source of infiltrating water into the tailings impoundment would be eliminated.

Over the long term, the water quality and sediment environment (benthic community) in Soda Butte Creek and Miller Creek are expected to improve by implementing this alternative. These streams are expected to benefit because the contaminant sources impacting the streams would be stabilized with respect to surface water erosion. Additionally, the alternative would improve the aesthetic quality of the area. The long-term effectiveness should be monitored by frequent inspections of the reclaimed wastes and subsequent maintenance, when necessary.

8.5.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The primary objective of this alternative is to provide a significant reduction in contaminant mobility; the volume or toxicity of the wastes would not be reduced by this alternative. The primary waste sources of concern would be rendered immobile in an engineered structure and physical location that is protected from erosion problems. Completely removing and capping the tailings and waste rock would stabilize the wastes and reduce contaminant mobility via surface water and wind erosion. Groundwater impacts would also be reduced by decreasing infiltration through the wastes by increasing evapotranspiration processes, as well as by removing a major source of infiltrating water into the tailings (relocation of Soda Butte Creek back into the valley bottom). The mobility of the on-site contaminants is expected to be reduced to an extent that would result in an overall (all pathways and all routes of exposure considered) risk reduction of 97 percent (based on modeling results).

The performance of the un-lined repository with a multi-layered cap, from the standpoint of reducing infiltration of percolating leachate to groundwater, was estimated using EPA’s HELP Model (Version 3.0). Output from the HELP Model is included in Appendix F. Implementation of Alternative 5b is predicted to reduce infiltration of leachate at the McLaren Tailings Site by 93.67 percent.

8.5.5 Short-Term Effectiveness

It is anticipated that the construction phase of this alternative would be accomplished in a relatively short time period (one field season); therefore, impacts associated with construction would be short term and minimal. On-site workers would be adequately protected during the construction phase by utilizing appropriate personal protective equipment and by following proper operating and safety procedures; however, short-term water quality and air quality impacts to the surrounding environment may occur due to the large volumes of wastes requiring handling. Control of fugitive dust emissions would be provided by applying water (via water truck) to surfaces receiving heavy vehicular traffic, or in excavation areas, etc.

Short-term impacts to the surrounding community may be appreciable considering the proximity of the site in relation to Cooke City, which has a relatively small resident population but receives considerable tourist traffic throughout most of the year. Short-term impacts to the surrounding community would involve increased local vehicle traffic and associated safety hazards, as well as increased noise levels and dust generation. Application of water to roads in areas may become necessary if dust generation is significant.

This alternative may impart short-term impacts on Soda Butte Creek (and possibly Miller Creek) due to the need to work in close proximity to the streams and excavate wastes from the floodplains. Additionally, this alternative may require installation of a surface water diversion structure(s) in Soda Butte Creek and/or Miller Creek to allow reconstruction of the stream channels through the existing footprint of the tailings impoundment. However, the existing by-pass channel that runs on the north side of the tailings impoundment could likely be utilized as a diversion to convey the majority of the flow of the streams while the channels are reconstructed.

Short-term impacts to environmental resources are difficult to quantify; however, every effort would be made to minimize impacts to Soda Butte Creek and potential downstream receptors during implementation of this alternative. Partial excavation of the tailings impoundment would expose un-weathered (reduced) tailings materials to water and oxygen that could potentially result in an increased production of ARD over the short term. To minimize this possibility, the newly exposed tailings would be isolated from excess water to the extent practical via dewatering during the excavation process. Dewatering would likely consist of construction of a series of trenches and sumps, and installation of pumps to remove excess water from the immediate excavation area. The exact dewatering method to be employed would be determined during the detailed design phase of the project. Application for water quality permits, required as part of State and Federal Agency approval of the reclamation plan, would also aid in planning for protecting Soda Butte Creek from short-term impacts during the construction phase of the project. Additionally, BMPs would be required to be implemented during construction to protect surface water resources.

8.5.6 Implementability

This alternative is both technically and administratively feasible, and could be implemented in a relatively short period of time (one construction season, assuming favorable weather conditions at 7,600 feet elevation). The excavation, hauling, compacting, grading, capping, and revegetation steps required are considered conventional construction practices; materials and construction methods are readily available. Also, design methods and requirements are well documented and well understood. However, the construction steps required to implement this alternative are considered moderately difficult due to the need to work with wet tailings.

Factors that could affect the implementability of this alternative include the potential to encounter significant groundwater beneath the tailings when excavating and attempting to operate heavy equipment on wet tailings. If significant groundwater is encountered when excavating the materials, dewatering (i.e., pumping) will likely be required during construction. Additionally, pre-treatment of wet materials may be necessary to eliminate free liquids to attain compaction specifications in the repository. De-watering and/or pre-treatment, if required, could significantly increase project costs. Significant groundwater was not encountered beneath the tailings during the 2001 field investigation; however, the investigation was conducted during September (when the groundwater hydrograph is typically at its minimum) under regional drought conditions.

8.5.7 Costs

The total cost for this alternative has been estimated at $4,170,877.00, which represents the reclamation of all solid media contaminant sources present at the McLaren Tailings Site. Table D-4, in Appendix D, presents the cost details and assumptions associated with implementing this alternative.

8.6 ALTERNATIVE 5c: ON-SITE DISPOSAL IN A CONSTRUCTED REPOSITORY WITH A SOIL COVER

Section 7.3.7 of this document presents the conceptual design, design assumptions, logistics, and construction details associated with Alternative 5c.

8.6.1 Overall Protection of Human Health and the Environment

This alternative would provide a means of significantly reducing soil ingestion exposure to the COCs and would stabilize the surfaces of the sources with respect to migration to surface water. However, the reduction in risk to human health and the environment would not be sufficient to achieve the risk reductions dictated by the risk assessment. Alternative 5c would sufficiently mitigate the migration of contaminants and degradation of groundwater and surface water quality, but would not provide sufficient reduction of soil ingestion exposure.

Significant protection of human health would be achieved under this alternative. Reduction of human exposures to COCs via the pathways of concern, as identified in the human health risk assessment, would occur. Soil ingestion exposure to COCs via contaminated surface soil would not be sufficiently reduced to meet the residential risk reduction levels. Groundwater ingestion of Fe would be reduced enough to meet the residential risk level.

Significant protection of the environment would also be achieved under this alternative. Sufficient reduction of one ecologic exposure would not occur: plant phytotoxicity to Cu would not be sufficiently reduced.

A risk reduction achievement matrix (Table 8-9) was developed to assess whether the alternative affords sufficient protection to human health and the environment for the pathways and COCs identified in the human health risk assessment (Section 5.1) and the ecological risk assessment (Section 5.2). The conclusions presented on the table are based on worst-case modeling results and are subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-9
RISK REDUCTION ACHIEVEMENT MATRIX - ALTERNATIVE 5c

Alternative 5c	**As**	**Cd**	**Cu**	**Fe**	**Zn**	**Overall**
Human Health Exposure Pathways:						
Soil Ingestion	Res.	Res.	Res.	Recr.	Res.	Recr.
Water Ingestion	Res.	Res.	Res.	Res.	Res.	Res.
Ecologic Exposure Pathways:						
Surface Water	--	--	--	–	--	Yes
Sediments	--	--	--	--	--	Yes
Plant Phytotoxicity	--	Yes	No	--	--	No

-- = Risk reduction not required for the contaminant for that pathway.
Recr. = Achieves required risk reduction for the recreational exposure scenario.
Res. = Achieves required risk reduction for the residential exposure scenario (most protective).

8.6.2 Compliance with ARARs

All location-specific and action-specific ARARs would be met by implementing this alternative. There are no numerical standards (ARARs) that are required to be met for contaminated solid media. Water quality ARARs are expected to be achieved by this alternative. A water quality ARARs attainment matrix (Table 8-10) was developed to assess whether the alternative can achieve ARARs for those contaminants and media where they are exceeded. The conclusions presented on the table are based on worst-case modeling results and are subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-10
WATER QUALITY ARARs ATTAINMENT FOR ALTERNATIVE 5c

Alternative 5c	**As**	**Cd**	**Cu**	**Fe**	**Pb**	**Zn**
On-site Groundwater (µg/L)	1.3	0.2	NM	44	1.2	NM
On-site Surface Water (µg/L)	1.6	0.2	2	47	1.2	12
On-site Groundwater ARARs	Yes	Yes	--	Yes	Yes	--
On-site Surface Water ARARs	Yes	Yes	Yes	Yes	Yes	Yes

Groundwater ARARs are State HHSs.
Surface water ARARs are State HHSs or Acute AWQC, whichever is lower.
NM = Contaminant not modeled (Cu and Zn not included in TCLP suite).
µg/L = micrograms per Liter

On-site groundwater and surface water would meet water quality ARARs under this alternative.

8.6.3 Long-Term Effectiveness and Permanence

Under this alternative, the constructed repository would have to be maintained to ensure that it continues to perform as designed. The actual design life of the repository is not certain; consequently, long-term monitoring and routine inspection and maintenance would be required. The soil cover installed over the repository would be the component most vulnerable to any damage or degradation that might occur. Soil covers are susceptible to settlement, ponding of surface water, erosion, and disruption of cover integrity by vehicles, deep-rooting vegetation, and burrowing animals. However, the cover could be easily inspected and the required maintenance could be easily determined and performed.

Under this alternative, the tailings impoundment would be completely removed from its current, potentially unstable location directly in the valley bottom of the Soda Butte Creek drainage; consequently, the risk of catastrophic failure of the tailings dam would be eliminated. Additionally, with the tailings completely removed and Soda Butte Creek returned to its original location in the valley bottom, a perennial source of infiltrating water into the tailings impoundment would be eliminated.

Over the long term, the water quality and sediment environment (benthic community) in Soda Butte Creek and Miller Creek are expected to improve by implementing this alternative. These streams are expected to benefit because the contaminant sources impacting the streams would be stabilized with respect to surface water erosion. Additionally, the alternative would improve the aesthetic quality of the area. The long-term effectiveness should be monitored by frequent inspections of the reclaimed wastes and subsequent maintenance, when necessary.

8.6.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The primary objective of this alternative is to provide a significant reduction in contaminant mobility; the volume or toxicity of the wastes would not be reduced by this alternative. The primary waste source of concern would be stabilized in an engineered structure and physical location that is protected from erosion problems. Completely removing and covering the tailings and in-place grading and revegetation of the waste rock dump would stabilize the wastes and reduce contaminant mobility via surface water and wind erosion. Groundwater impacts would also be reduced by decreasing infiltration through the wastes by increasing evapotranspiration processes, as well as by removing a major source of infiltrating water into the tailings (relocation of Soda Butte Creek back into the valley bottom). The mobility of the on-site contaminants is expected to be reduced to an extent that would result in an overall (all pathways and all routes of exposure considered) risk reduction of 91 percent (based on modeling results).

The performance of the repository, from the standpoint of reducing infiltration of percolating leachate to groundwater, was estimated using EPA's HELP Model (Version 3.0). Output from the HELP Model is included in Appendix F. Implementation of Alternative 5b is predicted to reduce infiltration of leachate at the McLaren Tailings Site by 89.17 percent.

8.6.5 Short-Term Effectiveness

It is anticipated that the construction phase of this alternative would be accomplished in a relatively short time period (one field season); therefore, impacts associated with construction would be short term and minimal. On-site workers would be adequately protected during the construction phase by utilizing appropriate personal protective equipment and by following proper operating and safety procedures; however, short-term water quality and air quality impacts to the surrounding environment may occur due to the large volumes of wastes requiring handling. Control of fugitive dust emissions would be provided by applying water (via water truck) to surfaces receiving heavy vehicular traffic, or in excavation areas, etc.

Short-term impacts to the surrounding community may be appreciable considering the proximity of the site in relation to Cooke City, which has a relatively small resident population but receives considerable tourist traffic throughout most of the year. Short-term impacts to the surrounding community would involve increased local vehicle traffic and associated safety hazards, as well as increased noise levels and dust generation. Application of water to roads in areas may become necessary if dust generation is significant.

This alternative may impart short-term impacts on Soda Butte Creek (and possibly Miller Creek) due to the need to work in close proximity to the streams and excavate wastes from the floodplains. Additionally, this alternative may require installation of a surface water diversion structure(s) in Soda Butte Creek and/or Miller Creek to allow reconstruction of the stream channels through the existing footprint of the tailings impoundment. However, the existing by-pass channel that runs on the north side of the tailings impoundment could likely be utilized as a diversion to convey the majority of the flow of the streams while the channels are reconstructed.

Short-term impacts to environmental resources are difficult to quantify; however, every effort would be made to minimize impacts to Soda Butte Creek and potential downstream receptors during implementation of this alternative. Partial excavation of the tailings impoundment would expose un-weathered (reduced) tailings materials to water and oxygen that could potentially result in an increased production of ARD over the short term. To minimize this possibility, the newly exposed tailings would be isolated from excess water to the extent practical via dewatering during the excavation process. Dewatering would likely consist of construction of a series of trenches and sumps, and installation of pumps to remove excess water from the immediate excavation area. The exact dewatering method to be employed would be determined during the detailed design phase of the project. Application for water quality permits, required as part of State and Federal Agency approval of the reclamation plan, would also aid in planning for protecting Soda Butte Creek from short-term impacts during the construction phase of the project. Additionally, BMPs would be required to be implemented during construction to protect surface water resources.

8.6.6 Implementability

This alternative is both technically and administratively feasible, and could be implemented in a relatively short period of time (one construction season, assuming favorable weather conditions at 7,600 feet elevation). The excavation, hauling, compacting, grading, capping, and revegetation steps required are considered conventional construction practices; materials and construction methods are readily available. Also, design methods and requirements are well documented and well understood. However, the construction steps required to implement this alternative are considered moderately difficult due to the need to work with wet tailings.

Factors that could affect the implementability of this alternative include the potential to encounter significant groundwater beneath the tailings when excavating and attempting to operate heavy equipment on wet tailings. If significant groundwater is encountered when excavating the materials, dewatering (i.e., pumping) will likely be required during construction. Additionally, pre-treatment of wet materials may be necessary to eliminate free liquids to attain compaction specifications in the repository. De-watering and/or pre-treatment, if required, could significantly increase project costs. Significant groundwater was not encountered beneath the tailings during the 2001 field investigation; however, the investigation was conducted during September (when the groundwater hydrograph is typically at its minimum) under regional drought conditions.

8.6.7 Costs

The total cost for this alternative has been estimated at $3,720,031.00, which represents the reclamation of all solid media contaminant sources present at the McLaren Tailings Site. Table D-5, in Appendix D, presents the cost details and assumptions associated with implementing this alternative.

8.7 ALTERNATIVE 6: OFF-SITE DISPOSAL IN A NEARBY MINE WASTE

REPOSITORY

Section 7.3.8 of this document presents the conceptual design, design assumptions, logistics, and construction details associated with Alternative 6.

8.7.1 Overall Protection of Human Health and the Environment

This alternative would provide a means of significantly reducing soil ingestion exposure to the COCs and would stabilize the surfaces of the sources with respect to migration to surface water. The reduction in risk to human health and the environment would be sufficient to achieve the risk reductions dictated by the risk assessment. Alternative 6 would sufficiently mitigate the migration of contaminants and degradation of groundwater and surface water quality, and provides sufficient reduction of soil ingestion exposure.

Significant protection of human health would be achieved under this alternative. Reduction of human exposures to the COCs via the pathways of concern, as identified in the human health risk assessment, would occur. Soil ingestion exposure to COCs via contaminated surface soil would be sufficiently reduced for the residential risk reduction levels. Groundwater ingestion of Fe would also be reduced enough to meet residential risk levels.

Significant protection of the environment would also be achieved under this alternative. Reduction of ecologic exposures, via the scenarios identified in the ecologic risk assessment, would occur: plant phytotoxicity to Cu would be sufficiently reduced.

A risk reduction achievement matrix (Table 8-11) was developed to assess whether the alternative affords sufficient protection to human health and the environment for the pathways and COCs identified in the human health risk assessment (Section 5.1) and the ecological risk assessment (Section 5.2). The conclusions presented on the table are based on worst-case modeling results and are subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-11
RISK REDUCTION ACHIEVEMENT MATRIX - ALTERNATIVE 6

Alternative 6	As	Cd	Cu	Fe	Zn	Overall
Human Health Exposure Pathways:						
Soil Ingestion	Res.	Res.	Res.	Res.	Res.	Res.
Water Ingestion	Res.	Res.	Res.	Res.	Res.	Res.
Ecologic Exposure Pathways:						
Surface Water	--	--	--	–	--	Yes
Sediments	--	--	--	--	--	Yes
Plant Phytotoxicity	--	Yes	Yes	--	--	Yes

-- = Risk reduction not required for the contaminant for that pathway.
Recr. = Achieves required risk reduction for the recreational exposure scenario.
Res. = Achieves required risk reduction for the residential exposure scenario (most protective).

8.7.2 Compliance with ARARs

All location-specific and action-specific ARARs would be met by implementing this alternative. There are no numerical standards (ARARs) that are required to be met for contaminated solid media. Water quality ARARs are expected to be achieved by this alternative. A water quality ARARs attainment matrix (Table 8-12) was developed to assess whether the alternative can achieve ARARs for those contaminants and media where they are exceeded. The conclusions presented in the table are based on worst-case modeling results subject to the limitations and assumptions used in the models (see Section 8.1 for discussion).

TABLE 8-12
WATER QUALITY ARARs ATTAINMENT FOR ALTERNATIVE 6

Alternative 6	As	Cd	Cu	Fe	Pb	Zn
On-site Groundwater (µg/L)	1.0	0.04	NM	7.8	0.8	NM
On-site Surface water (µg/L)	1.6	0.1	2	16	1.2	12
On-site Groundwater ARARs	Yes	Yes	--	Yes	Yes	--
On-site Surface Water ARARs	Yes	Yes	Yes	Yes	Yes	Yes

Groundwater ARARs are State HHSs.
Surface water ARARs are State HHSs or Acute AWQC, whichever is lower.
NM = Contaminant not modeled (Cu and Zn not included in TCLP suite).

On-site groundwater and surface water would meet water quality ARARs under this alternative.

8.7.3 Long-Term Effectiveness and Permanence

Under this alternative, the tailings impoundment would be completely removed from the site; consequently, the risk of catastrophic failure of the tailings dam would be eliminated. Additionally, with the tailings completely removed and Soda Butte Creek returned to its original location in the valley bottom, a perennial source of infiltrating water into the tailings impoundment would be eliminated.

Over the long term, the water quality and sediment environment (benthic community) in Soda Butte Creek and Miller Creek are expected to improve by implementing this alternative. These streams are expected to benefit because the contaminant sources impacting the streams would be completely removed from their current location. Additionally, the alternative would improve the aesthetic quality of the area. The long-term effectiveness should be monitored by frequent inspections of the reclaimed areas and subsequent maintenance, when necessary.

8.7.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Under this alternative, the volume of waste completely removed from the site is estimated at 267,200 cubic yards. This is expected to provide virtually 100 percent reduction in contaminant mobility at the site. The mobility of the on-site contaminants is expected to be reduced to an extent that would result in an overall (all pathways and all routes of exposure considered) risk reduction of 100 percent based on modeling results).

8.7.5 Short-Term Effectiveness

It is anticipated that the construction phase of this alternative could be accomplished in a relatively short time period (one or two field seasons); therefore, impacts associated with construction would be short term. However, this alternative could result in major inconvenience to nearby residents and tourists if the tailings are hauled to the disposal facility via a public roadway (i.e., Highway 212). Assuming that the work was specified to be completed in a single calendar year under a 75-day construction contract, utilizing 20 cubic yard capacity over-the-road (OTR) haul trucks and a 12-hour work day, at minimum production, a total of 141 loaded trucks would leave and re-enter the site each day (a haul truck would be entering the highway from the site once every 5 minutes). Obviously, this scenario would require significant traffic control and would still be potentially dangerous.

A more suitable scenario would likely involve construction of an exclusive haul road for the project, which originates at the site and terminates at the disposal facility; however, crossing of Highway 212 could still be required under this scenario (depending on the location of the off-site disposal facility). Construction of a two-way haul road up to 5 miles in length and capable of handling the required traffic would result in a significant capital investment (which is not accounted for in the cost estimate for Alternative 6).

On-site workers would be adequately protected during the construction phase by utilizing appropriate personal protective equipment and by following proper operating and safety procedures; however, short-term water quality and air quality impacts to the surrounding environment may occur due to the large volumes of wastes requiring handling. Control of fugitive dust emissions would be provided by applying water (via water truck) to surfaces receiving heavy vehicular traffic, or in excavation areas, etc.

Short-term impacts to the surrounding community may be appreciable considering the proximity of the site in relation to Cooke City, which has a relatively small resident population but receives considerable tourist traffic throughout most of the year. Short-term impacts to the surrounding community would involve increased local vehicle traffic and associated safety hazards, as well as increased noise levels and dust generation. Application of water to roads in areas may become necessary if dust generation is significant.

This alternative may impart short-term impacts on Soda Butte Creek (and possibly Miller Creek) due to the need to work in close proximity to the streams and excavate wastes from the floodplains. Additionally, this alternative may require installation of a surface water diversion structure(s) in Soda Butte Creek and/or Miller Creek to allow reconstruction of the stream channels through the existing footprint of the tailings impoundment. However, the existing by-pass channel that runs on the north side of the tailings impoundment could likely be utilized as a diversion to convey the majority of the flow of the streams while the channels are reconstructed.

Short-term impacts to environmental resources are difficult to quantify; however, every effort would be made to minimize impacts to Soda Butte Creek and potential downstream receptors during implementation of this alternative. Partial excavation of the tailings impoundment would expose un-weathered (reduced) tailings materials to water and oxygen that could potentially result in an increased production of ARD over the short term. To minimize this possibility, the newly exposed tailings would be isolated from excess water to the extent practical via dewatering during the excavation process. Dewatering would likely consist of construction of a series of trenches and sumps, and installation of pumps to remove excess water from the immediate excavation area. The exact dewatering method to be employed would be determined during the detailed design phase of the project. Application for water quality permits, required as part of State and Federal Agency approval of the reclamation plan, would also aid in planning for protecting Soda Butte Creek from short-term impacts during the construction phase of the project. Additionally, BMPs would be required to be implemented during construction to protect surface water resources.

8.7.6 Implementability

This alternative is both technically and administratively feasible, and could be implemented in a relatively short period of time (one or two construction seasons, assuming favorable weather conditions at 7,600 feet elevation). The excavation, hauling, compacting, grading, capping, and revegetation steps required are considered conventional construction practices; materials and construction methods are readily available. Also, design methods and requirements are well documented and well understood. However, the construction steps required to implement this alternative are considered moderately difficult due to the need to work with wet tailings.

Factors that could affect the implementability of this alternative include the potential to encounter significant groundwater beneath the tailings when excavating, attempting to operate heavy equipment on wet tailings, and significant inconvenience to local residents and tourists if public roadways need to be utilized or crossed when hauling wastes off-site. If significant groundwater is encountered when excavating the materials, dewatering (i.e., pumping) will likely be required during construction. Additionally, pre-treatment of wet materials may be necessary to eliminate free liquids to attain compaction specifications in the repository. De-watering and/or pre-treatment, if required, could significantly increase project costs. Significant groundwater was not encountered beneath the tailings during the 2001 field investigation; however, the investigation was conducted during September (when the groundwater hydrograph is typically at its minimum) under regional drought conditions.

8.7.7 Costs

The total cost for this alternative has been estimated at $7,107,655.00, which represents the reclamation of all solid media contaminant sources present at the McLaren Tailings Site. Table D-5, in Appendix D, presents the cost details and assumptions associated with implementing this alternative.